Approaches developed to build TSO capabilities in Morocco and to assess the safety of experiments in its TRIGA Research Reactor

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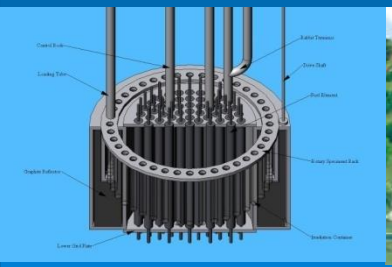


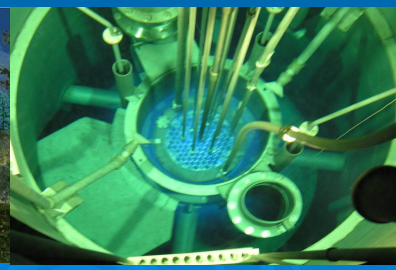

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Outline

- Presentation of TRIGA Mark II RR
- Safety organization at CNESTEN
- Categorization and review of experiments
- Practical implementation of the approach developed for the production of I-131
- Building TSO capabilities using international cooperation
- Conclusion

Presentation of TRIGA Mark II Research Reactor

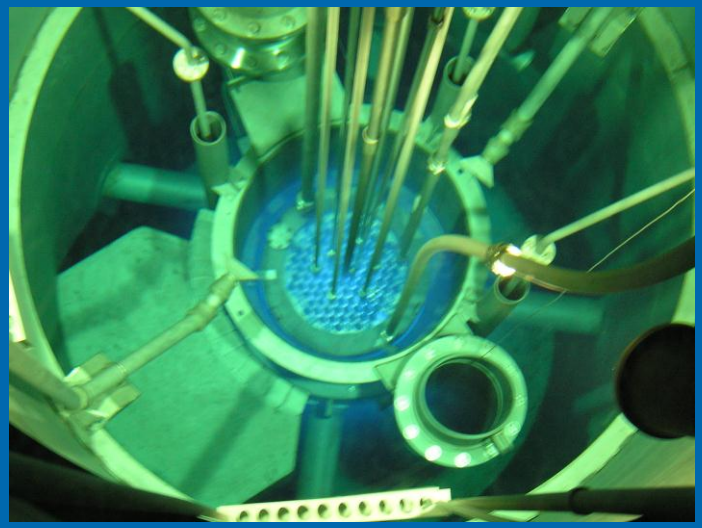
MAAMORA NUCLEAR CENTER

Presentation of CENM TRIGA Mark II RR

- Design — Standard Mk II
- Power — 2 MW (t)
- Cooling — Natural Convection
- Fuel — U-ZrH

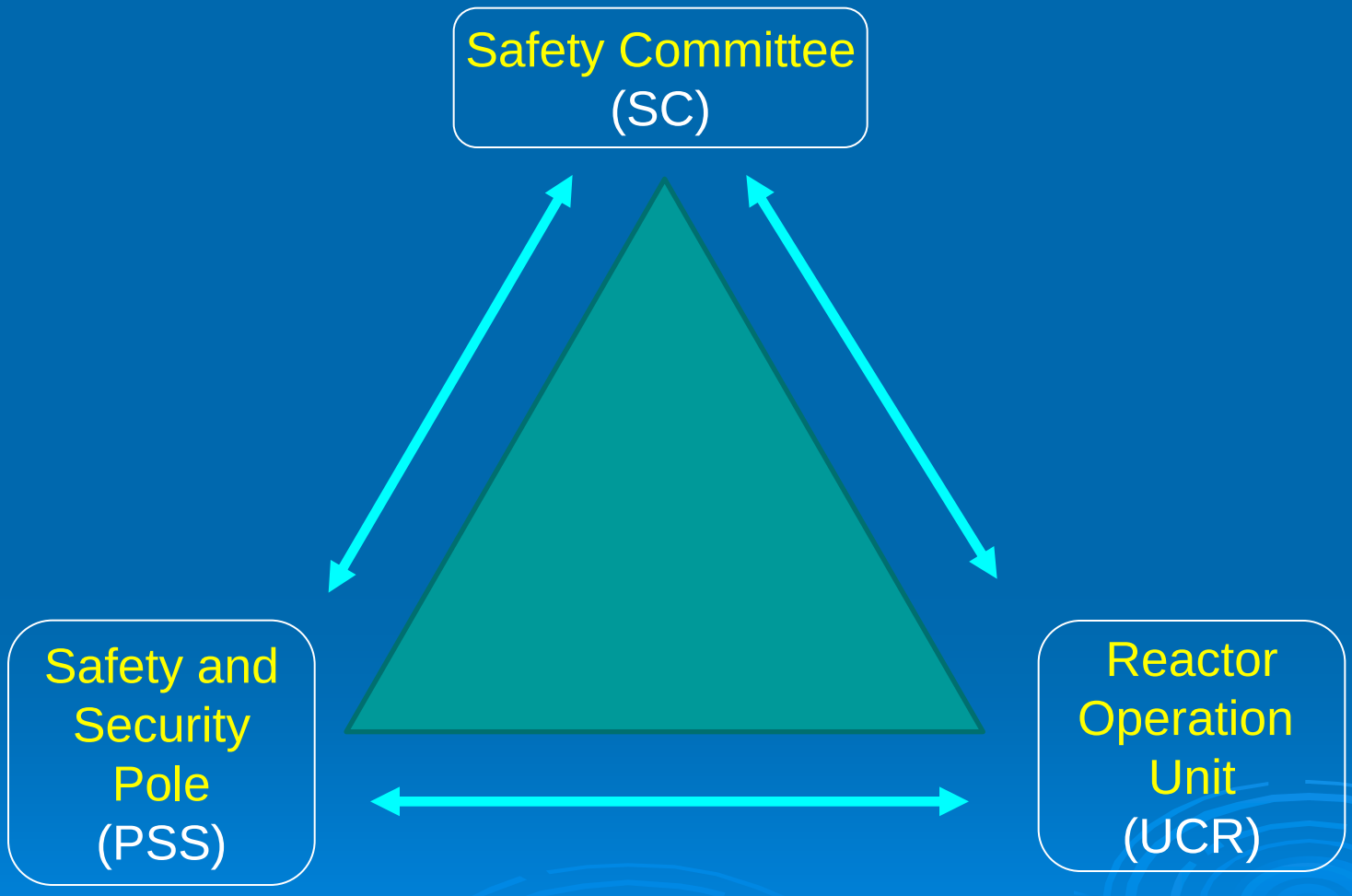
Presentation of CENM TRIGA Mark II RR

- Reactor Features
  - Graphite Reflector
  - Beam Tubes (4)
  - Thermal Column
  - Pneumatic Transfer System
  - Rotary Specimen Rack
  - In-pool fuel storage racks



Safety organization at CNESTEN

Safety Organization at CNESTEN



Fields of work of Safety and Security Pole (PSS)

- Nuclear safety;
- Radiological and industrial safety;
- Dosimetry, Calibration, Monitoring network
- Environmental protection;
- Physical protection;
- Emergency preparedness and response;
- Safeguards.

Safety Committee (SC) : Aspects reviewed

- Commissioning Program (CP) and its results,
- Treatment of abnormal events,
- Proposed experiments,
- Modifications having an impact on safety level,
- Rules, procedures and instructions of the reactor operation,

Safety Committee (SC) : Aspects reviewed (Con't)

- Results of safety audits relative to the operation of reactor,
- Violations of the OLCs, the license and procedures that are significant to safety,
- Events that are required to be reported to the Safety Authority,
- Safety documents.

Categorization and review of experiments

Establishment of review and approval process

- Establishment by CNESTEN of a draft approach of categorization and review of experiments in compliance with the IAEA draft safety guide DS397 “Safety in the Use and Modification of Research Reactors”

- Review of this approach during an IRSN Expertise Mission (December 2009)

- Approval by CNESTEN of the above mentioned approach

Framework of experiment safety

- National regulation and licenses;
- Final Safety Analysis Report (FSAR), including OLCs;
- IAEA safety Standards:
  - Code NS-R-4 “Safety requirements for RR”;
  - Guide 35-G2 “Safety in the utilization and modification of RR”;
- International practices (USA, France)

Experiment classification and review

Category (a)	Category (b)	Category (c)
Hazards covered by similar experiments previously approved by Safety Committee	- Modifications brought to the framework of experiments previously authorized	- Changes in the OLCs; - Hazards different in nature or more likely to occur than those previously considered (FSAR)

UCR (Reactor Operation Unit)	Approval	Preparation of Safety doc.	Preparation of Safety doc.
PSS (Safety & Security Pole)		Independent Analysis	Independent Analysis
Safety Committee		Review and approval	Review
Safety Authority			Review and approval

Safety document

- Purpose and justification for the experiment;
- Experimental devices;
- Characterization of target to be irradiated (confinement) and of reactor operation;
- Impact of experiment on the reactor safety :
  - Reactivity;
  - Thermalhydraulic;
  - Chemical hazards;
- Integrity of confinement;

Safety document (con't)

- Assessment of doses to reactor staff and presentation of radiation protection measures;
- Calculation of radiological consequences in accident conditions,
- Assessment of compliance to licensing conditions and FSAR;
- Commissioning process;
- Operational procedures;

Safety document (con't)

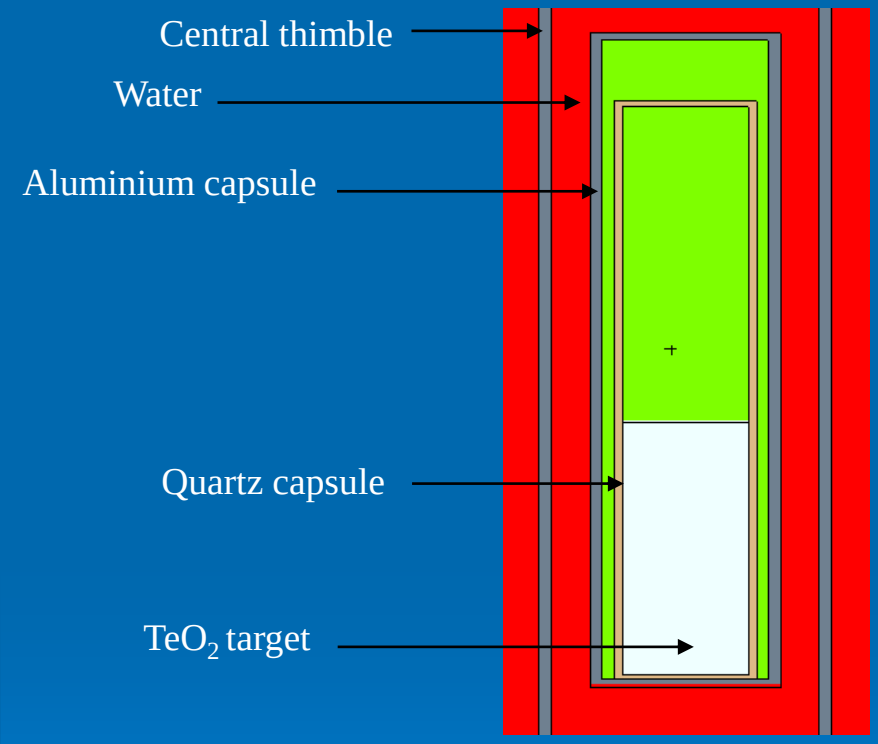
- Radioactive waste and effluents generated;
- Special requirements for the training and, if necessary, relicensing of reactor operators.

Practical implementation of approach developed for the production of I-131

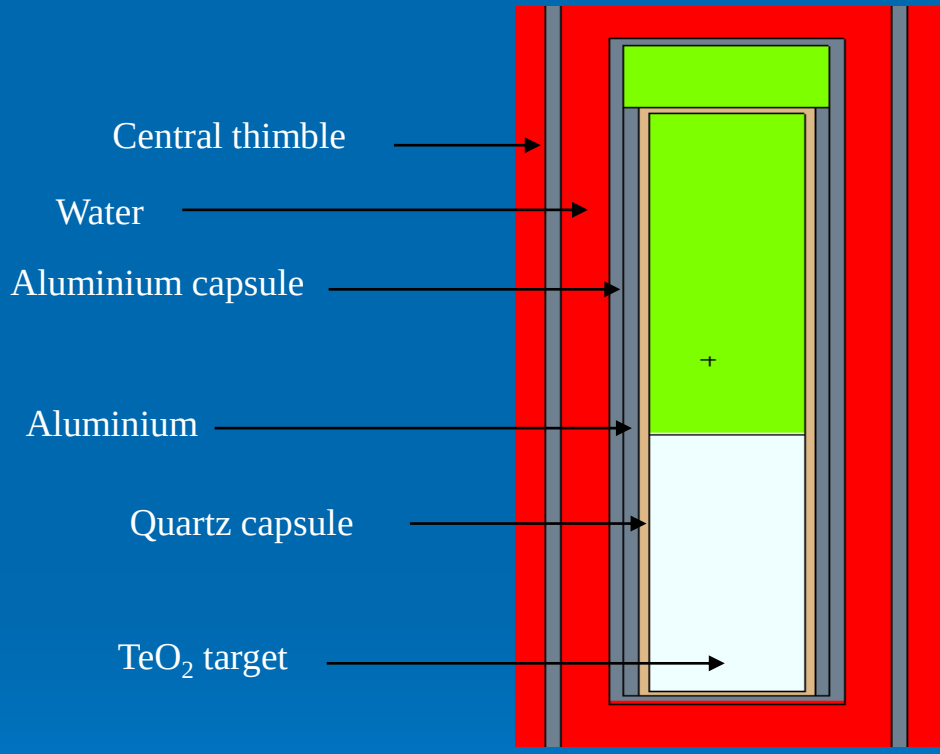
Review of I-131 production experiment

- Preparation and submission of Safety Document of the experiment by the Reactor Operation Unit
- An independent analysis and a safety assessment were carried out by the Safety and Security Pole (PSS)
- Organization of an IRSN expertise mission to review the safety assessment made by PSS
- Identification of specific safety issues which deserved to be studied in detail, in accordance with the experiments safety assessment approach
- Approval route of this experiment (Safety Committee) :
  - Validation of encapsulation and extraction process
  - Approval to conduct the experiment following a graded approach

Encapsulation : 2 Configurations

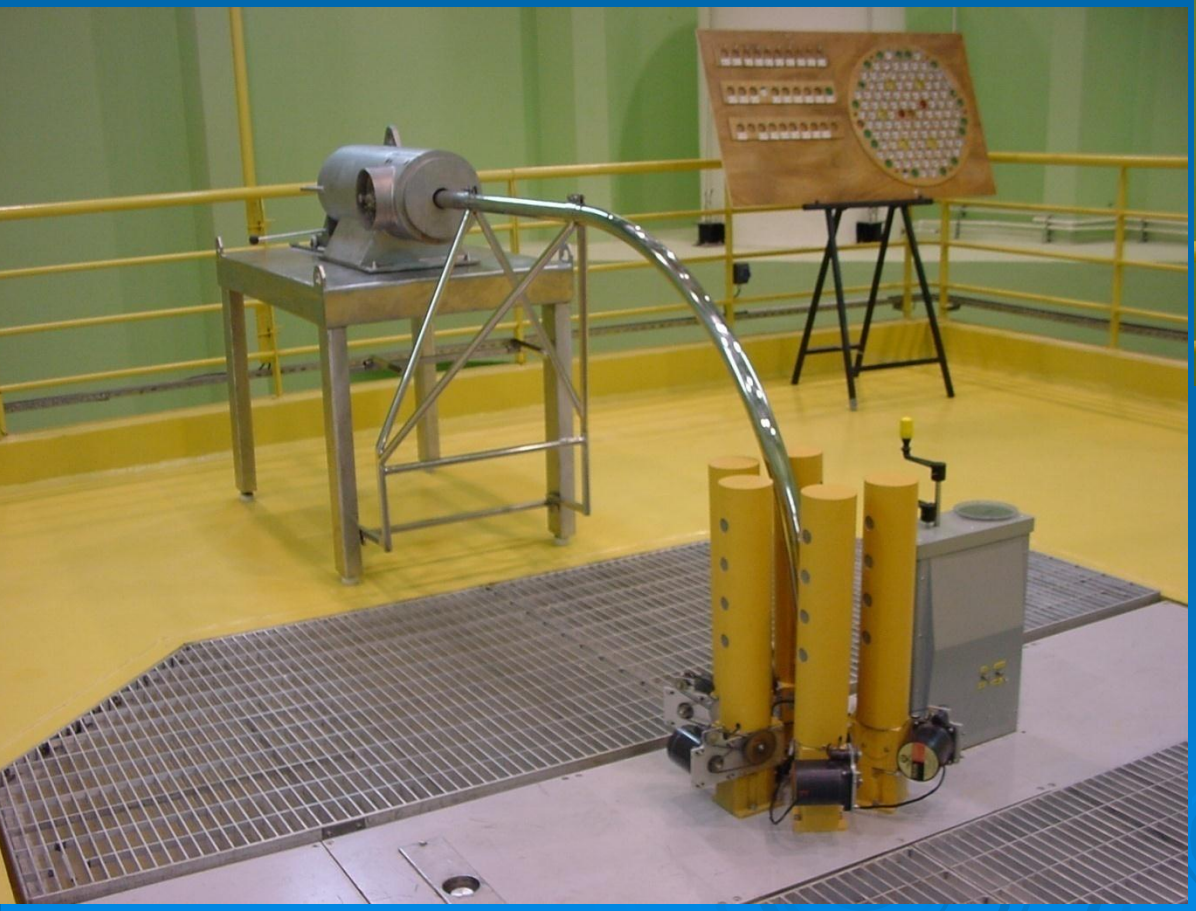


Configuration 1

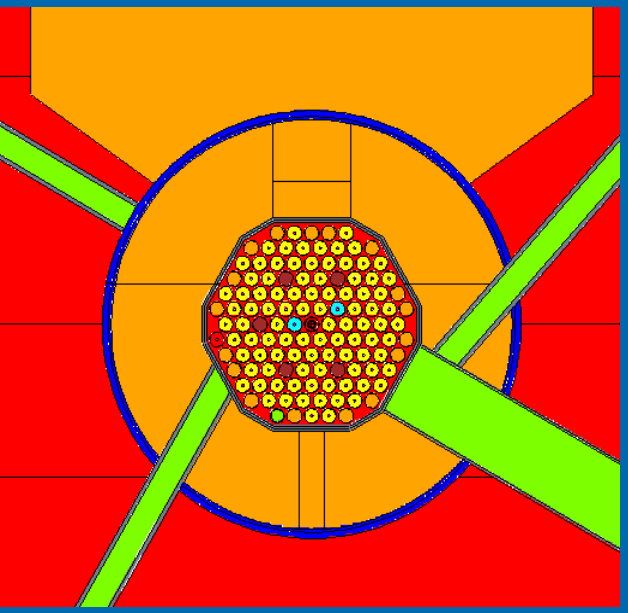


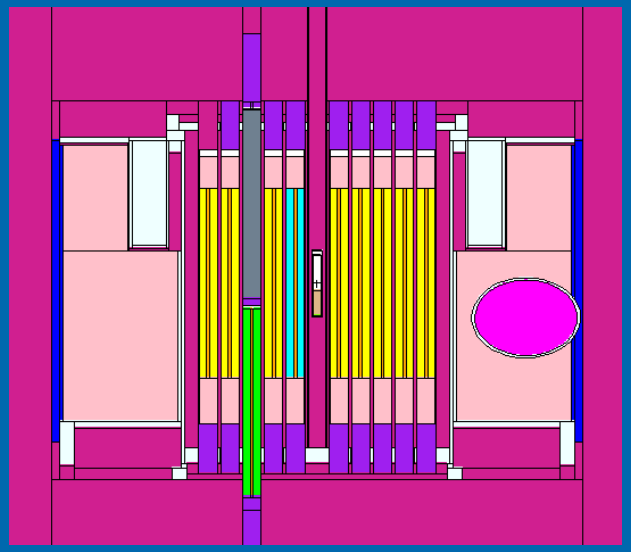
Configuration 2

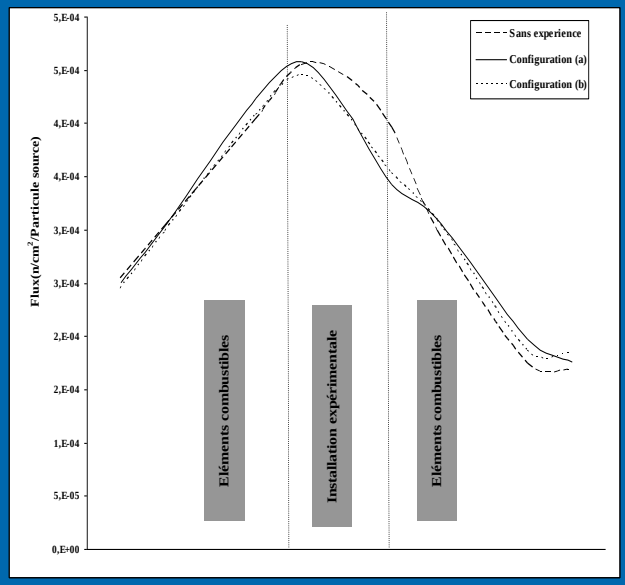
Extraction



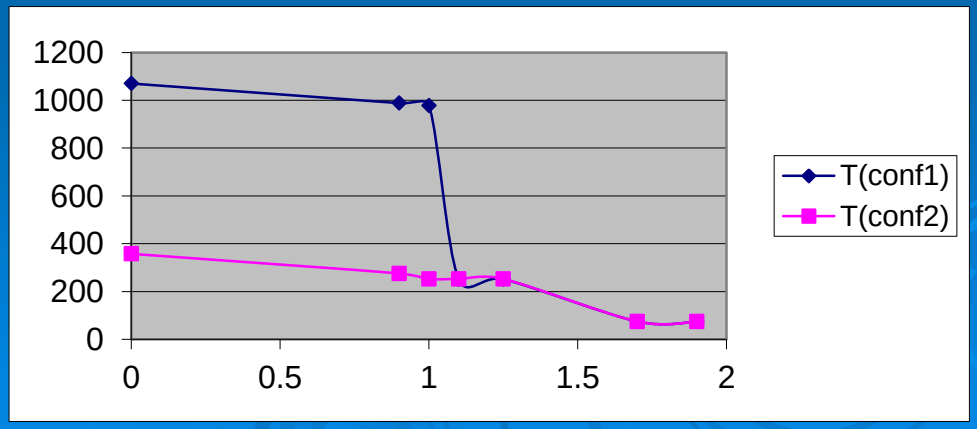
Independent Safety Analysis (PSS)







Neutron calculation



Thermal calculation

Independent safety analysis (PSS) Radiological impact calculation for accidents

- IAEA CRP «Modeling and Analysis of Radionuclides Transport and Source Term Evaluation within Containment / Confinement and Release to the Environment for Research Reactors ».

- IAEA Safety Report n° 53 « Derivation of the Source Term and Analysis of the Radiological Consequences of Research Reactor Accidents » ;

Independent safety analysis
Radiological impact calculation for accidents

- RSAC-6 code (Radiological Safety Analysis Computer program) ;
- Code HOTSPOT (version 2.07) ;
- Microshield Code.

Ref. : Hotspot user guide, March 2010

Building TSO capabilities using international cooperation

Building TSO capabilities using international cooperation

- A Nuclear and radiological Safety and Security law will be soon adopted by Morocco,

- This law foresees the creation of a new unique and independent Regulatory Body which will need to rely on the support of CNESTEN as TSO for safety assessment and review,

- In this perspective, CNESTEN is reinforcing its human resources and developing skills in framework of international cooperation, mainly with the IRSN, IAEA, European Commission and USA.

Building TSO capabilities using international cooperation

- Several countries have acquired a huge experience on nuclear plants:
  - The organization of international cooperation for countries willing to launch into nuclear technology is a good mean to update with the state of the art of the “safety culture”.
  - This approach leads to a standardization of safety practices to a high level.

- The CNESTEN acquired an experience in the area of safety through:
  - the follow-up for the TRIGA reactor,
  - International cooperation

Conclusions

Conclusions

- CNESTEN has developed the infrastructure needed and capabilities necessary to ensure an independent follow-up on safety level of TRIGA Reactor :
  - The set up of an effective safety committee with required skills,
  - The adoption of an approach regarding the safety review process of experiments constitute important steps to fulfill the national regulations and the IAEA safety standards.
  - The implementation of best practices.
  - The organization at the critical steps of independant safety reviews in frawework of international cooperation (IAEA, IRSN),

THANK YOU FOR YOUR ATTENTION